The article outlines a methodology for conducting injectivity tests in Middle East, aimed at demonstrating the feasibility of Carbon Capture, Utilization, and Sequestration (CCUS). It provides details about the development of both surface and downhole testing setups, as well as insights gained and suggestions for future tests.

The scope of the project covered the dynamic multi-zone reservoir evaluation with saline aquifers. The purpose of the injectivity test was to verify the initial well seal integrity, reservoir injectivity, and surface injection pressure. Various injectivity tests were conducted, involving the injection of water, N2, and CO2 at different levels followed by a fall-off phase. The Surface Testing System was utilized to inject, control, and regulate the flow, as well as monitor the injection pressure and temperature. The Downhole Testing System was implemented through either a Monobore completion or drillstem test tools (DST), with pressure and temperature measurements taken at various depths using wireless real-time telemetry.

During the first stage of the campaign, water was injected up to the fracture pressure to validate the seal integrity. Subsequently, water and N2 injection tests were carried out to establish the reservoir injectivity using various fluids. These tests involved injectivity profiling to evaluate the zonal injectivity distribution of the reservoir. Once the initial assessment of reservoir injectivity was completed and the reservoir for CCUS CO2 injection was selected, CO2 injection tests were performed.

The surface system utilized for CO2 injection was a combination of a standard frac unit and surface well testing equipment. The frac unit consisted of water tanks, HP pump for water injectivity testing and CO2 transport and storage tanks, CO2 vaporizer, CO2 booster, CO2 Pump for CO2 injectivity test. The surface data acquisition included the injection pressure and temperature. The flow-rates were calculated by pump stroke movement which was then tuned against the volumes in storage tanks. Injected CO2 was in a liquid phase which was achieved by keeping the pressure of 300 psi and temperature of 0 deg F at surface.

The downhole testing system was required to provide the completion integrity and real-time data to efficiently conduct the CO2 injection. The cooling effect resulting from the CO2 injection caused significant temperature changes within the well. The slip joints for DST with mechanical packer or free to move stinger in the sealbore of the hydraulic packer is considered to compensate for the length reduction during CO2 injection. The real-time downhole data was crucial to avoid the formation fracturing and achieve the test objectives thanks to real-time interpretation. Authors have noticed the limitations of traditional quartz gauges in a cold CO2 environment and developed the recommendations to acquire accurate downhole pressure data.
The authors conducted the injectivity test with CO2 for the first time at the appraisal wells. Based on their experience with more than 10 wells and 4-6 individual injectivity tests, they will present a distinct workflow, as well as insights gained for the industry.